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Editor's Column . . . . . M. R. Sfat '43

On March 14, the CORNELL ENGINEER experienced its fifty-fifth change of boards. When the class of 1941 left Room 40 in Lincoln Hall for the last time, it left a great heritage to its successors. During the past year, this publication has seen one of the most prosperous years in its history. It has recovered from the financial ailments of the depression and has been injected with a new and vigorous editorial policy. It is the sincere desire of the entering Senior Board to continue the progressive measures adopted by the previous Senior Boards.

The CORNELL ENGINEER takes pleasure in announcing the election of W. E. Kennedy and C. H. Davidson as alumni members of the Advisory Board. Both of these men are well qualified for their positions and will add greatly to the publication.

The Senior Editorial Board for the ensuing year consists of the following: Editor-in-Chief, Mircea R. Sfat, ChemE '43; Managing Editor, Henry E. Otto, Jr., AE '42; Assistant Editor, Thomas M. Wilson, EE '42; and Associate Editors, Willard S. Levings, AE '42, and John B. Sullivan, EE '42.

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As in the past, it will be the policy of this publication to print articles which are contributed by Cornellians. Our University is particularly fortunate in having many alumni, professors, and graduate students who are leaders in their fields. By using articles which are written by Cornellians, two purposes are served: 1. The reader receives sound technical information written by an authority; 2. The type of work which Cornell engineers are doing is related to the rest of the Cornell engineers, both students and alumni. This last point is of especial significance today. The bond which this publication strives to maintain is but a link in the new order of College-alumni relationships. Continued success of the program of the College of Engineering, as outlined by Dean Hollister in our last issue, depends to a large extent upon the unity which the alumni and College can maintain collectively.

The editorial staff of the CORNELL ENGINEER does not intend to operate on the basis on which the technical journals of the various societies and publishing houses operate. Our field of endeavor will be restricted to presenting as accurately and completely as possible the activities of alumni, the research and developments of the College, and the activities of the student body.

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The CORNELL ENGINEER

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An Ultra-Modern Vertical Milling Machine

In Defense Of Defense

TELL BERNA, M.E. '12

As Told to the Editors

Engineering today represents a culture of very great importance, and a very substantial part of the foundation on which our society is built. On the accomplishments of the engineer depend the standards of living which make possible the maintenance of cultural activity in music, art, literature, and pure science. His role in time of national emergency is obvious.

Metal-working, for example, though as highly developed as medicine, archaeology, anthropology, or international law, lacks the distinction which the others possess, perhaps because of its relative youth. The shop foreman who knows how to process a piece of steel so precisely that it may best serve a specific engineering purpose, commands not nearly the respect accorded to one who has a profound knowledge of law or medicine. But just as metal-working is not simply a combination of smoke, gas, dirt, dust, and grime, the engineer is not merely a man with rolled-up sleeves, a notebook, a stubby pencil, and a hip-pocket slide-rule. He is the motor that drives the wheels of industry, in times of peace supplying the genius which makes possible progress in pure science and medicine, in times of emergency applying his genius to the most effective production of the country's industrial needs.

Metamorphosis

In modern warfare many types of machines are needed, each of which must be designed to perform more or less specific services. The problem of the engineer is rendered the more difficult by the fact that machines which were serviceable in time of peace for production of common consumer goods cannot for the most part be used for the manufacture of war materials. Turning out a Chrysler is not like making a tank; nor can the same production methods he applied in the manufacture of electric refrigerators and machine guns. Obviously there is a period of readjustment required when automotive production facilities are diverted to the manufacture of tanks.

Rock Island arsenal, in the capacity of a research department, constructed a few tanks which they subjected to various tests to see that all military requirements were met. When this model was approved, a contract was awarded to Chrysler for the production of these tanks in large quantities.

Following the period of his first training, with the Cutler-Hammer Company, for whom he was a branch manager for seven years, Tell Berna has successively occupied the positions of sales manager of the G. A. Gray Company, general sales manager for Union Twist Drill Company, and (for seven years) sales manager with the National Acme Company. Since 1937 he has been general manager of the National Machine Tool Builders' Association.

His twenty-one years in the machine tool field give him a wide acquaintanceship in metal working plants throughout the country. Through the association's work during the past year, Mr. Berna has been in close touch with the plans and activities of the machine tool section of the Advisory Commission to the National Denfense Council in Washington.

How did Chrysler solve this problem? Chrysler could not use the production data available at Rock Island, for the latter produced only a few tanks; his was a mass production problem. Because the cheapest, fastest, and most efficient way of making one or two tanks would not prove the most satisfactory for mass production, he had to start at the beginning. An entirely new plant was needed, with complete and highly specialized equipment. His next step was to build a wooden model to scale. While faults detected in erecting the wooden model were being remedied, he installed, let us assume, one vertical boring mill, one grinder, one milling machine, and two lathes. This would create an "unbalanced line," for the one boring mill is sufficient to serve, say 30 lathes, 2 grinders, and 4 milling machines. But, and this is important, instead of placing an order for this additional equipment at the same time the initial equipment was ordered, Chrysler waited until he had made a few tanks. In this way he found that if a special fixture or attachment were added to his lathes and improvements were made upon the milling machines, his output would be considerably increased. These desired improvements were included in the order specifications for the specialized machines. If those special functions desired by Chrysler could not be performed by existing models, new ones were designed.

Specialized machines are not only

Row of Tool Grinders for Sharpening All Types of Form Tools

desirable—they are essential. Improvements are being made at such a phenomenal rate that a machine of 1930 design, even though it looks like a present day model, is not satisfactory when compared to present machines for much of the exacting work now required. This inherently high degree of obsolescence, because of the multiplicity of new developments, in combination with the rapid expansion and contraction of American metal-working industries, accounts for the extreme fluctuation in demand for machine tools. In the peak year of 1929 the volume of sales was $185,000,000. Following the decline to $22,000,000 in 1932, sales rose to $25,000,000 in 1933. The years 1936 and 1937 saw European nations placing orders for American machine tools, the best in the world. War orders had a profound effect on the industry; in 1939 the total shipments were up to $200,000,000, a figure which was more than doubled in 1940. For 1941 shipments are estimated at $750,000,000.

Long before that final order for the remainder of tank production equipment was placed with the machine tool builder, numerous changes were being made within the plant. The skills of the men had to be developed along new lines. Some men were good for just one type of work; others could be readily adapted to new work—and were. In short, the right man had to be selected for the right job. Apprentices replaced the skilled laborers in jobs which did not require too much skill, leaving skilled men to the more difficult and exacting tasks. A boy with natural aptitude may be taught to operate a lathe satisfactorily in three months, but to become a good tool or die maker to work to one ten-thousandth of an inch precision requires years of experience. There is no short cut.

Competent executives with an engineering background had to be trained to supervise the manufacture of this new product, and their knowledge of the problems which are confronted in the manufacture of tanks had to be broadened. Solutions to such problems had to be found without loss of valuable time.

Executive departments had to be decentralized so that specialized knowledge could be more effectively applied; slow points in the production flow chart had to be eliminated; and a steady output had to be attained by using all available facilities.

By over-expanding the working force, however, the skilled leadership may be so diluted that even with three shifts a day the production may be disappointingly small in proportion to that which would have been possible by a single completely skilled shift. The present general tendency in the machine tool industry is toward two shifts, each working overtime for just this reason.

Defense Bottlenecks

In the metamorphosis of any industrial concern from peacetime manufacturing to emergency production, there are many "choke points" which tend to prevent the achievement of a smooth, highly-efficient system of making various types of war material.

First, the needs of the defense program must be clearly defined. This is a problem for the Army and Navy general staffs, and it is a most difficult one because of many variables that must be taken into account, and the constant changes in the situation. When they decide what is needed, contracts must be made with private industry. In order to eliminate "red tape," informal understandings or agreements are quickly made between the government department concerned and the industrial source, so that production may be started without delay.

Shortage of special equipment and metal stocks, such as structural and alloy steels, presents a second "bottleneck." Although our general over-all capacity to produce is adequate to satisfy the manufacturers' needs, a long time may be necessary to fill the order if specialized machines of unusual quantities of alloy steel are required.

Technical and supervisory ability further adds to the delay. In some cases men who don't want responsibility must be induced to assume it, and less skilled men must replace them. I have in mind the case of a highly-skilled mechanic who had worked for twenty years in a certain plant and knew its operations thoroughly. One of the foremen died and he was asked to succeed him. He replied with emotion, "No, I have worked with the boys in this plant for twenty years; I can't boss them around now." And he wouldn't accept the position. Such men must be made to

realize their importance to industry and to the Government in this time of national emergency, and must undertake the responsibility involved.

The shortage of gages is another factor which helps account for the delay in the expansion of industry to meet war-time needs. Tremendous numbers of jigs and fixtures, all special in nature, and requiring highly skilled workmanship, present another problem.

The system of priorities, a very necessary part of our program, is installed to prevent delay and eliminate unnecessary confusion. Priorities are administered by the Office of Production Management with the cooperation of the Army and Navy Munitions Board. In its work with the machine tool industry, the board establishes priority as to delivery, depending on the importance of each project in the national defense program. Thus an order which arrived first might not be delivered first. For example, assume that B, a manufacturer of bicycles, placed an order for a milling machine two months ago, and that today it is found that if one more milling machine could be installed in the newly-constructed plant of C, who is making gun mounts, C's output could be increased by 10%. Because the machine tool industry is so active that production of machines ordered two months ago will just be in its initial stages, the Tool Section of the Office of Production Management asks the Priorities Section to divert the machine to C, and allow B a later delivery. B may be entitled to receive his machine first, but is, nevertheless, asked to use his present equipment for the time being. Concerns not working on government order are, in general, very cooperative in this respect, but the orders of the Priorities Division of the Office of Production Management have lately been made mandatory.

In the case of two concerns, each manufacturing ordnance material, the relative importance of their respective products to the defense program, as well as the effect of this one machine on their respective rates of output, would be considered. Thus Garand rifles may take prefence over 75 mm. shells.

Any plan which could be devised would undoubtedly have its tight spots, which must be opened. There is always a limiting factor in a production line, whether in lack of material, personnel, or equipment, or in a priorities restriction. The general idea of this current program is to complete a well-rounded plan as soon as possible, consistent with giving sufficient aid to Britain. In every part of this program, the engineer has a fundamental role. The situation places a new emphasis on the proper development of engineering education and on deflecting well-trained men into that field, not only to care for present defense requirements, but also to insure that we can cope successfully with the tremendous task of meeting our peace-time needs after the present emergency is over.

What Is The Emergency?

No matter how skilfully a plan is formulated, there will always be criticism. It is quite natural that those who have had no experience in the problems of industrial production wonder why so long a time elapses between defense appropriations and the delivery of completed weapons. We have capable and cooperative officers in Washington, as well as an excellent Office of Production Management. We must not underrate the tremendous difficulties they face in expediting so huge a program.

We are by no means so remote from European disturbances as many of us think. Suppose that Britain were to lose the war and that Canada made a treaty with the German Reich. There might be a steady flow of German engineers, business men and workers to Canada. We may suddenly find that our neighbor in the north has become an ally of the Reich. (Don't for a moment think that Germany will forgive us after the war for our unqualified support of the British.) Our middle west is unprotected and would be an ideal entrance for an invader. Or suppose that Germany bought or traded her way into Mexico or a South American country, from which an attack could be launched against the United States, perhaps with the aid of Japan.

These statements are not alarmist propaganda. These are possibilities which must be considered in planning our defense program. Where shall important plants be located? The relative importance of vulnerability to attack, proximity to the source of raw materials, location of skilled labor supply, ultimate destination of finished product, and availability of shipping facilities—all must be weighed before we can even decide where plants should be located.

Then, too, on what type of equipment should production be concentrated? After the fall of Holland,

(*Continued on page 23*)

Six-Spindle Automatic Bar Machine Turning Gear from Solid Shaft

Yellow River Regulation

Translated from the Chinese by

CHEN-HSU T'ANG, Ph.D.

IN THREE PARTS

PART II—River Channel Stability

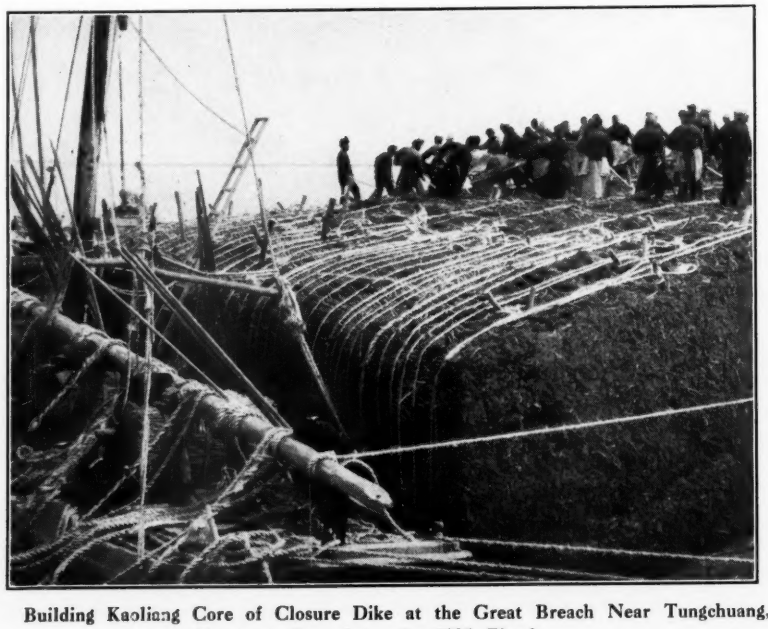
We have already analyzed a number of different opinions concerning river regulation and will not dwell on them further. At this point we will discuss the first of those points that will be of most value in further investigation.

1. *The river channel must not be unstable.* After the river channel is stabilized it will naturally scour its channel deeper. Mr. Engel's proposal of fixing a mean-water channel was also based on the principle. However, this principle has one weakness: during flood stages the water will rise above the mean-water channel and the main current still can shift without restriction, thus again creating a dangerous situation. Mr. Engels states that once the mean-water channel is stabilized the river channel will never approach the dikes. If the river never approaches the dike there will never be a threatened* portion. But the direction of the main current at flood stage does not always follow the direction of the main current at mean- and low-water stages. Usually the river channel runs in a northeasterly direction and the main current has a tendency to flow more or less in a southeasterly direction. Therefore, it is not true that there will be no threatened sections if the mean-water channel is fixed. Morever, dike failures have occurred more in unthreatened sections than in threatened sections. In most cases the cause of dike failures has been overtopping rather than impingement. Even if we regulate the river so that there will be no threatened sections, there is still no guarantee that dike failures will not occur.

Cuts are by courtesy of the American Society of Civil Engineers, who in the December, 1938, issue of their *Proceedings* published an article by Major O. J. Todd and S. E. Eliassen entitled, "The Yellow River Problem."

We must not discount Mr. Engel's idea, because once the mean channel of the river is stabilized then there is some basis upon which to regulate the direction of flow; otherwise the river becomes similar to an unbridled wild horse, and there is nothing to do but sit back and fear the worst.

Which type of cross-section will be the better for the Yellow River in the future—the single-type or the double-type cross section? In a recent letter, Mr. Engels states that assuming the mean-water channel to be fixed we may expect the river to scour out the bed of the mean-water channel. The foreshores will silt up naturally, and will build up higher and higher as a result of



Building Kaoliang Core of Closure Dike at the Great Breach Near Tungchuang, Shantung, Caused by the 1935 Floods

*Ed. Note: Threatened portion (literally "dangerous works") refers to that portion of the dike which is especially threatened by the danger of the main current's approaching or impinging on the dike. This portion may require special protective work or attention. Unthreatened portion (literally "peaceful works") refers to those dike portions where the main current does not approach or strike the dikes and where only routine maintenance is necessary.

Well Built Stone-Protected Groin Pointing Down Stream Along South Bank of Yellow River, 20 Miles Below Loku

scouring and flooding; eventually the flood-water and mean-water channels will become one. The double-type cross section thus becomes the single-type cross section. From this we can see that the single-type section is Mr. Engels' preference. The Commission agrees with Mr. Engels on this point.

What is the reason for preference of the single-type cross section? The double-type cross section is used because the flood discharge is too large and the single-type section is not able to accommodate the discharges. The double-type section, therefore, is used so the water can expand on both sides of the mean-water channel. However, the cross section of the flood-channel bed is usually very shallow and also rough. As a result the rapidity of discharge is reduced and the flood-water channel becomes a temporary storage area. Since the Yellow River contains a high silt content, it would be regrettable if we did not concentrate (in a single-type section) the available force in the flood discharges so as to transport the silt to the sea.

The Yellow River Commission believes it will be better to let the present river cross section gradually change to the single-type section. With a knowledge of the silt and flow conditions of this river we can determine the suitable cross section accordingly. The single-type section, providing only for mean water and normal flood water, serves practically the same purposes as the double-type section, because the unpredictable floods which might occur once in a number of years can be neglected or provided for by some other better means, such as detention basins on the upper river to hold the unpredictable flood water during an emergency.

According to the discharge measurements at Shanchow, the following table is prepared (record for a period of 13 years):

TABLE 2

Year	Maximum discharge in cubic meters per second
1919	6,900
1920	4,300
1921	5,600
1922	4,800*
1923	6,300*
1924	3,200*
1925	6,700*
1926	5,000
1927	4,200*
1928	3,500*
1929	4,700
1930	No record
1931	No record
1932	5,500
1933	14,300**

The frequency of discharge from the above table can be listed as follows:

Discharge above	Number of Occurences	Percentage
10,000 cu m per sec	1	8
6,000 cu m per sec	4	30+
5,000 cu m per sec	7	60+
4,000 cu m per sec	11	90—
3,000 cu m per sec	13	100

*Discharges derived from rating curve of 1920 and 1921, not by actual discharge measurements. If we derived the discharges from the rating curve of 1932, 1933, and 1934 the figures would be much higher.

**According to the estimations of Chapter 3 the figure is larger than this.

In designing a river channel, it is necessary to allow a margin of safety with regard to discharge capacities. Of course, it will be a mistake to use minimum discharge in planning the cross section. On the other hand maximum discharges are usually three or four times as large as normal flood discharges. The frequency of maximum flood discharge may not be more than once in 300 to 500 years. From the point of view of engineering economics, it is not possible to use this figure as a basis in design. Again, if we adopt the single-type cross section, it is not possible to accommodate the maximum flood discharges. Even if it were possible to do so, the disadvantages would outweigh the advantages. The river can be compared to a hotel. If there are many guests, constantly coming and going, it will be kept in good repair; if the guests are few and far between, it will run down. The Commission, therefore, proposes to provide only for the frequently occurring, normal flood waters in designing the cross section. The normal flood water will not cause serious damages in the lower reaches of the river and will still retain the capacity for adequate scouring of silt. For normal flood water the figure 6,500 cu. m. per sec will be tentatively assumed. Investigation and any necessary correction of this figure should be made at a later date after further study.

Using the figure 6,500 cu. m. per sec for discharge capacity, and knowing the slope of the water surface at different points during flood discharge and the roughness of the river bed, we may compute the standard cross section (trajectory type). We obtain the width from this. Within this standard width the river should scour out the bed to coincide with the theoretical cross section. The foreshore on either side of the standard cross section should be aggraded as a result of silting.

It is very difficult to complete this process by the use of manual labor for the dredging. However, if we use the natural force of the river it is not very difficult, because the Yellow River inherently possesses this power. If we know how to utilize this power, then the purpose will be fulfilled.

Chi-Hsun Pan (Ming Dynasty 1368-1644 A. D.) used the "channel constriction" method, making the diked channel as narrow as possible in order to induce a more concentrated flow with greater velocities to scour the channel and to carry the silt and the flood water to the sea. This idea agrees very closely with the modern theory of regulation. Prof. Eelers of the Danzig Institute of Technology, and also Prof. Otto Franzius of the Hanover Institute of Technology agree with this theory. Prof. Franzius's paper on Yellow River Regulation, containing his plan and a description of experimental studies, has been published in *Hydraulic Engineering* (published in China). Since 1717 the dike-contraction method has been used to regulate the Mississippi River—the so-called 'Confinement Theory.' This theory was proposed by the Italian Guglielmini. Up to the present time no apparent results have been obtained on the Mississippi River from application of this theory. In like manner, application of the Chi-Hsun Pan method (same as the "Confinement Theory") on the Yellow River has also failed to produce any regulatory effects.

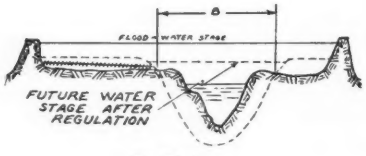


FIGURE 1

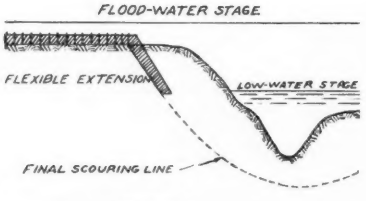


FIGURE 2

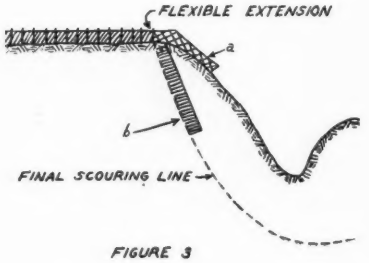


FIGURE 3

The Commission believes that a part of the channel-constriction theory is valid. One of the drawbacks of the dike system is that once the dike is built it is fixed, not flexible. In dike construction it is impossible, because of theoretical considerations, to build the works entirely according to predetermined location. It is sometimes necessary to change the predetermined locations for such reasons as the presence of unsuitable foundation soil, structures, or villages. Such departures from theoretical locations will affect the "Confinement Theory."

Mr. Franzius planned to use a system of inner and outer dikes. The space between inner and outer dikes was to be used for silting during flood stages. The inner dikes are smaller and weaker and are used to contract the channel, not for flood protection. He believes that even if the inner dikes were to break, this would not necessarily be disastrous. The Commission, however, is afraid that the river system would be further disturbed.

Mr. Engels, in his letter, stated that the contracting effect produced by the higher foreshores built up by natural silting would be much better than that produced by constructing inner dikes. The Commission agrees with this belief.

The results obtained in the Yellow River model studies conducted in Obernach, Germany, by Mr. Engels agree very well with actual conditions. Although the cross sections are very wide, the scouring of the river channel is quite considerable. Engels, in the conclusions drawn from his model studies, states that the ratio between the degree of scouring in the wide river bed and the degree of scouring in the narrow river bed is 16 to 1. Many people are surprised at this conclusion, because they are accustomed to the familiar formula

$$S=8\ 1H$$

(S = tractive force, 1 = hydraulic gradient, and H=depth of water in channel). Formerly the theory proposed by F. Kreuter stated that bed load will be moved when depth of water in the channel exceeds critical depth T_0. Other hydraulicians believe that the amount of bed load moved depends upon the magnitude of the velocity along the river bed. According to S. Kurzmann's investigations performed in nature on the Tyrolean Ache, the Kreuter theory and the theory stating that bed-load movement depends upon bottom velocity cannot be depended upon.

The Commission believes that even if we use the former theory, i.e., that tractive force is directly proportional to mean-water depth and directly proportional to hydraulic gradient, contraction of the channel by building dikes will produce an increase in the water depth, but a simultaneous decrease in the hydraulic gradient. Especially in the case in which a lower reach of the channel is contracted, the slope of the water surface upstream is considerably decreased. This might explain why the degree of scouring will be less for a narrow river channel than for a wide channel. According to Armin Schoklitsch's experiments, the effect of the hydraulic gradient 1 is very great. In a unit width (i.e., one meter) of river bed, the amount of bed load moved is directly proportional to the square of the hydraulic gradient and to the discharge Q minus the critical discharge Q_0 (the discharge at which bed-load particles just begin to move). His formula for the computation of the amount of annual bed-load transport is

$$G=C\ 1^2\ (Q-Q_0)$$

in which C is a coefficient. From this equation we can readily see that Engel's theory has a very sound basis.

How can we make the foreshores build up and the channel scour out deeper? The Commission does not believe that it is necessary to have the mean-water channel fixed exactly; it seems to be advisable to start operations on the foreshores and overbank areas first. The reasons are as follows: (1) The Yellow River is very irregular and it is very difficult to determine and fix the mean-water channel; (2) as a result of the channel's deepening due to scour the water-surface

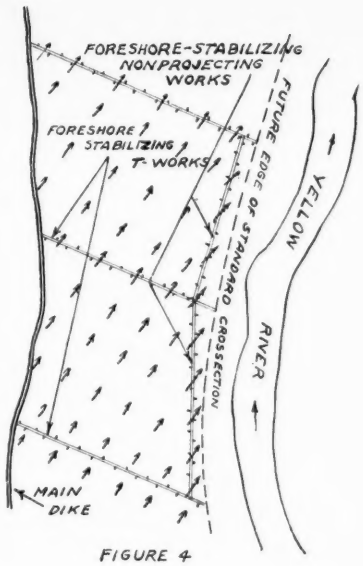


FIGURE 4

elevation will be lowered, and the future mean-water stage will be different from the present mean-water stage; (3) we wish to put the mean water and normal flood water into one channel, the natural scouring effect of the river will be affected.

The river bed may be stabilized by use of different hydraulic works: (1) Nonprojecting works (ED. NOTE: Literally "agreeable works"; i.e., a type of revetment or structure which runs parallel to the direction of current or bank) such as endless rollers, etc.; (2) T-works (ED. NOTE: Descriptive word to denote shape of structure; i.e., a structure projecting into the stream more or less perpendicular to the main dike or river bank) such as spur dikes, permeable T-dikes, floating dikes; (3) submerged dikes, (to prevent excessive scouring of the river bed); (4) bank-protective works, (5) branch-closure works (ED. NOTE: Procedure of diking off small branch or creek at its embouchure), and (6) cut-offs. Nonprojecting works and T-works are usually constructed with stone or small tree branches, and occasionally constructed with tree branches, stone, and sand together. Consequently, it is not possible to make any changes after the work is done. For this reason and the additional consideration of expense, great care should be taken at the time the work is executed.

The Commission intends to accomplish the purpose of "building up the foreshores and scouring the channel deeper." In designing and executing this work the following four requirements should be fulfilled: (1) cheapness, (2) flexibility—ability to follow changes in the river channel without losing usefulness, (3) avoidance of obstruction to the natural scouring effect of the river, (4) ability to be reinforced, extended, or added to at any time circumstances should necessitate such changes. We have devised a type of structure, based on the above four requirements, called "foreshore-stabilizing work."

The river-bed cross section is shown in figure 1 on the preceding page. The solid line outlines the river bed, the two dikes, and the water surface at the present time. The dashed lines show the future river bed and the water surface after river regulation (by method proposed here). The width of the channel is B. We are going to carry out "foreshore-stabilizing work" on both sides on the foreshore and overbank areas outside the standard width. This type of work is very simple. First, stakes are driven in single or double rows on these areas. The rows slant in a downstream direction (from the point of view of an observer looking downstream) and make an angle of 70° or 80° with the direction of flow. Willow withes will be woven in and out among the single rows of stakes to form low wattles. The spaces between the double rows of stakes will be filled with willow withes, weighted on top with stones, and tied securely with wires. This work does not need to be more than ½ to 1 m. in height as shown in figure 1 by the marking |-|-|-|; the distance between these works is from 500 to 1,000 meters. The front end of the work is flexible and from 30 to 50 m. long. No stakes are necessary for this flexible, protective extension, the end of which will be buried in the ground to a depth of 4 to 5 m. on the scouring line of the theoretical cross section and weighted down with stones. The scour will thus be guided and stopped at this limit, as shown by the dashed line in figure 2. If the works extend to the edge of the present channel then it is necessary to use the arrangement shown in figure 3. In this case the flexible extension simply lies on the bank and gradually moves downward with the scour. The "foreshore-stabilizing works" serve the following purposes: (1) they prevent bank attack and scour on the foreshore and overbank areas, (2) they obstruct overflow water and retard the velocity thus causing the transported silt to be deposited on the overbank areas. This effect can be increased by adding the same type of works along the foreshores parallel to the river (by the same method of construction), as shown in figure 4. The silt and mud will be retained on the overbank area and the clear water will seep back to the channel and thus increase the effectiveness of scour in the channel.

(*Continued on page* 22)

New Kaoliang Bank Protection Tied Back by Hemp Ropes, Along Yellow River, in Shantung

OUR RETIRI

This is the first of two writ ntrod been responsible for making the L EN past year. We, the newly elected memb tunity to express our appreciation excel us, and to wish them ss in

"Business Man"

Dave Bradt, ME

One always imagines the top man in any class to be a veritable grind. We hate to disappoint you, but Dave, who is the top man in the ME senior class, fills no such description. Short and witty, Dave has demonstrated his executive, as well as scholastic abilities, in the handling of his job as business manager of this magazine.

Dave likes to travel and has made several extensive trips throughout this country and "vicinity". The summer after his freshman year Dave took a trip to Mexico with his parents. Having seen the oil fields of Texas and the dusty plains of our Southwest, the Bradt family decided to head northwest the following summer; they explored the scenic Canadian Rockies and the lumber and salmon country of the State of Washington. On these trips Dave had an excellent opportunity to do some real photographing, a hobby in which he is quite interested. Last summer Dave worked as a draftsman and designer for the Worthington Pump Company; the experience he received was extremely valuable, Dave tells us, and he feels every undergraduate engineer should obtain summer employment in some phase of engineering work.

During his freshman year Dave was coxie for the frosh light crew—the second boat, he modestly points out. He likes golf and baseball and has represented his fraternity, Zeta Beta Tau, in these sports and has also served as treasurer for the chapter.

Recognition for his high scholastic rank in the ME school came in the form of election to Phi Kappa Phi. Dave is also the recipient of a John McMullen Regional Scholarship and, as we might naturally expect, his name has consistently appeared on the Dean's Honor List. Other honors not to be overlooked are membership in Tau Beta Pi and in Atmos, honorary mechanical engineering society.

It's hard for Dave to decide what job to accept for he has received numerous offers. He tells us his interests lie toward air conditioning and power plant work—both very important fields in our present national emergency. But with his ability and personality, we can vouch that Dave will be successful in either type of work in which he chooses to specialize.

Robert C. Ross, AE

Soon another class of seniors will be bidding farewell to Sibley and to the engineering campus they know so well. Many will leave with a feeling that they could have done better scholastically; others, scholars, will wish they had engaged in extra-curricular activities. But those who know Bob Ross personally will agree with us that his four years here may be looked upon as a panorama of accomplishment.

During his freshman year Bob did not waste any time becoming acclimated to his surroundings. He went out for track and cross-country, but became interested in the CORNELL ENGINEER and as a result had to sacrifice his track work. (Now relieved of his responsibilities in connection with this magazine, he has expressed a desire to go out for track this spring.)

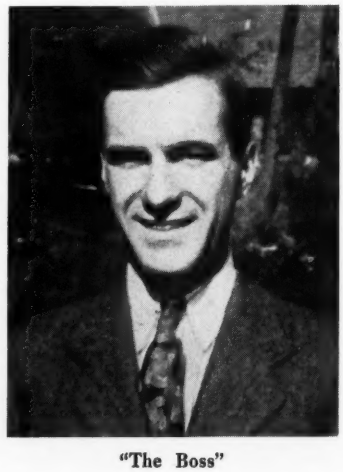
When his freshman year ended, Bob spent the summer at Camp Pioneer on Lake Seneca serving as village leader for a Rochester detachment of boy scouts. Bob enjoys working with people and is still active in scouting.

During the summer following his sophomore year, Bob went to the advanced Signal Corps Camp at Fort Monmouth. After the six weeks' training period experience, he acted as a camp leader at a boys' camp.

With the junior year came not only mech labs but also positions of considerable responsibility. Bob was elected chairman of the ASME, and just about a year ago stepped into the editorship of this magazine. Election to Tau Beta Pi and Kappa Tau Chi (of which he is vice-president) followed. But Bob also showed considerable interest in his military work; he earned a place in Scabbard and Blade, honorary military organization, and he joined Pi Tau Pi Sigma and the Officers' Club—both military in nature.

The summer after his junior year Bob, having completed his required R.O.T.C. summer training, got a job in the Wage Standards Department of the Eastman Kodak Company in Rochester, his home town. He received much practical administrative training in job evaluation, job specification, and time

(*Continued on page* 24)



"The Boss"

TIRNG SENIORS

of two writ troducing the seniors who have
making the L ENGINEER a success during the
wly elected members, wish to take this oppor-
ppreciation excellent training they have given
to wish them ss in the years to come.

"Right Hand Man"

Richard Durbin, ME

If there was ever a pradoxical situation regarding the employment of engineers, here is the prize: a mechanical engineer doing civil engineering work for a chemical engineering company. And this no less versatile person was Dick Durbin, member of the Class of '41 of Sibley School. As we talked with Dick in the Sigma Nu House, it became more and more apparent that he was quite pleased with that summer's work with the duPont regime, for he told us that at times he was chief layout engineer for a new chemical building—but hastened to explain that the cause for these rapid "promotions" was his boss' leaving to report to the home construction office. When we queried Dick as to his plans for the future, he intimated that he was practically certain where he would be employed, adding that he thought it no doubt would be in the Signal Corps of the U. S. Army.

As for vital statistics, Dick lives in Kenmore, near Buffalo; was born March 22, 1920; and entered Cornell in September, 1937. He refused to commit himself on anything further. But we did turn the conversation toward Cornell, and Dick gave forth with some very interesting personal history.

In the Reserve Officers' Training Corps here at Cornell, Dick has arisen to the rank of cadet major, Signal Corps. And further in the military line, Dick has been honored by membership in Pi Tau Pi Sigma, the Signal Corps fraternity; and in Scabbard and Blade. This last year he has been first sergeant, or secretary, of the latter organization. Further honors have come Dick's way, and include election to Atmos, honorary Mechanical Engineering society; membership on the Freshman Advisory Committee in his junior and senior years; membership on the Interfraternity Council in the fall of his junior year; and membership on the Editorial Boards of the CORNELL ENGINEER during his four years. He was elected to serve as assistant editor during his senior year, and in this capacity had much to do with the physical set-up of the magazine and its appearance.

Perhaps we should not fail to mention that Dick has served this year as house manager-treasurer of his fraternity, Sigma Nu, and we feel it only complimentary that he should at the same time maintain his excellent scholastic average.

George Vreeland, AE

That George Vreeland is eagerly looking forward to a spring vacation cruise to Bermuda is nothing out of the ordinary, as most of his life has been spent in traveling. George, in fact, is probably one of the most traveled men on the Hill. Born in Steubenville, Ohio, he has lived wherever his father's engineering profession took the family: in Buffalo, Chicago, London, Berlin, Pittsburgh, and the present Vreeland family headquarters, New York City.

It was practically ordained that George should enter Cornell; his father, a member of the class of '98, two cousins, and his prep-school room mate are all Cornellians. "It seemed natural that I should come here," he said. "I didn't even think of any other school." After spending three years at Kiski Academy, he went to Andover for a year and then returned to Kiski to complete his prep-school training and graduate. A tour through Scotland and France followed, after which George came to Ithaca to begin his freshman year in Administrative Engineering.

Being a college man did not mean settling down, however, for the summer after this first year was spent in cruising the Mediterranean. After his sophomore year George managed to forget the wanderlust, summering with his family at Cape Cod. As a junior officer in the ROTC, George was at Aberdeen, Maryland, location of the Army Ordnance Proving Grounds, for six weeks during the summer of his junior year. This period of hardy camp life he considered the most enjoyable of all. On his own from three 'til eleven p. m. daily and over the weekends, George remained true to form and traveled around. There were many weekend dashes to New York and Washington in the company of his brother officers, as well as trips to near-by Baltimore when time was shorter or excitement lacking in the other big towns.

Being a citizen of the world during and between school terms has not hindered George from finding his place on the Hill. He was a member of the Sophomore Cotillion

(*Continued on page* 24)

"Super-Salesman"

The Manufacture of Wine

MIRCEA R. SFAT, ChemE '43

In case you accept your glass of wine as merely a gift of nature, let Mr. Sfat show you that behind it lies painstaking effort, scientific principles and a tremendous amount of luck.

As an industry, wine making, which dates back more than two thousand years, ranks as one of the oldest of human occupations. Wine has always been associated with good living, and in many countries the quality and quantity of wine that a family possesses is a measure of that family's wealth. This condition is especially true of France, the home of so many famous wines. Even today, French wines, especially those of Bordeaux and Burgundy, bring tears of gratitude to discriminating connoisseurs the world over.

Wine Classification

There are many types of wine, and there are two general methods of classifying these types. First, there is the classical method based upon the location of manufacture. It is to this method that we owe the names of many of our wines, such as Burgundy, Johannisberger, and Clos Vouget. In some instances the names have lost the significance of their locality and have come to represent, through long usage, characteristics due to methods of manufacture. Examples of these are Port, Sherry, and Champagne.

The second method of wine classification, and the one which is of most value to the technician, is based upon the general characteristics of the wines. There are four dichotomous bases on which wines can be divided, namely: (1) dry or sweet, (2) fortified or unfortified, (3) sparkling or still, and (4) red or white.

Dry wines are those in which practically all of the sugar content has been converted to alcohol by fermentation. These wines are low in alcohol content (8-12 percent).

Sweet wines contain some unfermented sugar and have an alcohol content between 13 and 15 percent.

Unfortified wines are those whose alcohol content is derived entirely from fermentation of the grapes. Alcohol content may vary from 8-15 percent.

Fortified wines are those whose alcohol content is due in part to fermentation and part to the addition of spirits, usually in the form of apple brandy. Alcohol content lies between 18-22 percent.

Still wines are those whose fermentation has completed before bottling so that the carbon dioxide dissolved in the wine is that which the liquid can maintain in equilibrium with the external environment.

Sparkling wines are bottled before fermentation has ceased, and the carbon dioxide which is formed remains in solution at a pressure greater than atmospheric.

Red wines owe their color to the pigment of the grape skins and stems.

White wines are those which result from a fermentation of the grape juice only, thus eliminating the pigmentation due to the skins and stems.

By combination of the above characteristics, it is possible to obtain sixteen different categories into which wines may be classified. For example, claret is a dry, unfortified, still, red wine. However, champagne may be a fortified, sparkling, white, either sweet or dry wine, and many other wines can be placed in more than one category. For technical purposes, these categories, based on the composition, raw materials, and methods of manufacture, will suffice.

In principle, wine manufacture is a simple process. The grapes are crushed, the juice fermented and clarified, and the result is wine. However, there are many factors requiring close control in order to insure a palatable drink rather than a liquid which bears a strong resemblance to vinegar. Not only is the actual processing of the grapes important, but also of great importance is the condition of the untreated grapes, which depends upon the soil, climate, etc. These climatic and environmental conditions are beyond human control to a large extent, while processing is not. This article will deal with the manufacture of red wine and white wine, the two broad divisions of wine manufacture, and will exclude sparkling wines, such as champagne and sparkling burgundy. The latter wines are subject to a processing which entails a detailed discussion too voluminous for these pages.

Red Wine

Upon attaining the proper ripeness, the grapes are brought into the winery and immediately processed. If a delay occurs at this point, the grapes may become infected and the year's harvest will be ruined; therefore the manufacturer must work fast to prepare his grapes for fermentation.

First, the grapes are treated so as to remove the stems. This stemming process is effected by shaking or raking the grape bunches on a screen which can pass the grapes, but not the stems. In small wineries, hand operation of the stemmers is employed, and in larger wineries, machinery is used. It is necessary to remove the stems because they introduce substances which "brown" the color of the wine and ruin the wine flavor. They also introduce difficulties in handling the crushed mass of grapes.

In order to liberate the juice of the grapes and inoculate it with yeast, the grapes must be crushed. Many methods of crushing are employed, by far the most common being the use of a roll machine. This machine consists of two grooved rolls, turning toward each other at different speeds. The space between the rolls is such that the grapes can be crushed

without crushing the seeds. Following the crushing operation, the grapes are placed in fermenting vats where the most critical operation of all is carried out, fermentation.

Upon entering the fermentation tanks the grape juice (called must) is composed of sugar, organic acids, tannin, flavoring substances, proteins, mineral salts, pectin, and mucilaginous substances. Also present in the must are a large variety of yeasts, bacteria, and fungi, some of which enhance and others of which prevent wine formation. In most cases, the amount of unfavorable micro-organisms present is large enough to inhibit the proper fermentation processes. This condition entails a sterilization of the must by some method. Ordinarily, a process called defecation is used. This process consists of treating the must with sulfurous acid, and is usually accomplished by pumping the must into sulfurized casks. Unfortunately, this sterilization results in the elimination of the beneficial yeast in the must, and it is necessary to inoculate the must with a starter. There are two types of starters, the natural type and the pure yeast type. The former is made by fermenting a small number of the cleanest and soundest ripe grapes in the vineyard with the addition of a small amount of potassium meta-bisulfite. The pure yeast starter is one which is procured from a reliable source and grown under proper conditions to such a volume as to insure a good fermentation of the must.

Once fermentation has started, it is necessary to control the fermentation process very closely. Temperature control is of paramount importance, for it determines whether the alcohol-forming yeast or acid-forming bacteria will predominate in the process of fermentation. It has been found that the desired reactions take place between 70 and 80 degrees Fahrenheit. Fermentation is an exothermic reaction, and thus the reaction will build up the temperatures exceeding 80 degrees Fahrenheit unless some sort of control is used. Some wineries use water cooling coils, and in parts of California the vats are constructed of thin concrete walls so that the evaporation that occurs serves to effect some cooling. In some instances special strains of yeast, which have been trained to work at unusually low or high temperatures, are employed. As fermentation proceeds, carbon dioxide is formed and becomes entrapped in the grape skins and causes them to rise to the top of the vat. As a result, the cap of skins quickly ferments to completion and affords an excellent start to vinegar bacilli. Also, the pigment of the grape is oxidized and bleached. There are three methods employed today to handle this difficulty. One involves an open fermentation and then submerging the grape skins by manual means. The second method employs a grid which is about six inches below the level of the must and which keeps the skins below the surface. When using this latter method, uniform aeration and fermentation are obtained by pumping the liquor from the bottom of the tank to the top and allowing it to pour back. By combining these two methods, a third method results. The choice of the proper method is up to the individual taste of the wine-maker.

As fermentation proceeds, there are many chemical changes which occur, some of which are understood and some of which are not. The primary reaction is the transformation of grape sugar to alcohol and carbon dioxide. Some of the organic acid present in the must is consumed by the yeast. The acid which remains is primarily tartaric acid. Also partly consumed by the yeast is protein matter from the grapes. The end products of the protein transformation, organic acids, are converted to esters by the alcohol of the wine and contribute largely to its final bouquet. Tannin and pigment are extracted from the grape by the liquid, which is becoming richer in alcohol content due to fermentation. Tannin is of great importance in the soundness and clarity of the wine. The coloring matter of the red wine is a substance of unknown composition and it is not truly in solution in the ferment liquid. It is more probable that the pigment is present in a colloidal condition.

The rate of fermentation depends upon many factors, such as temperature, type of yeast, concentration of sugar in must, etc. It has been found by experience that the operation may take anywhere from three days to three weeks.

The next step is a separation of the ferment liquid from the solid matter of the grapes. There is a difference of opinion as to when the separation should be made, and practice varies from separating at a stage of incomplete fermentation to separation three weeks after the period of violent fermentation. In all cases, a good grade of wine results. There are three separations made on the ferment vat mixture, each of which results in a different grade of wine.

The first separation is a draining process. This results in a liquid which will mature more rapidly than the succeeding pressings, and so it is kept apart from the pressings which are later made. After a complete draining of the vat mixture, the saturated residue is transferred to a press and a further recovery of liquid results. This liquid produces a wine inferior to the drainage, but it is fit for human consumption. If a winery is interested in quantity of wine rather than quality of wine, a third separation is carried out. To effect this third separation, the previously pressed grape pulp is moistened with water and pressed again to recover any extractable material that might be left. Those who have no sense of taste and possess a cast iron stomach might be able to drink wine made of this third pressing, but to a well instructed connoisseur, this sort of wine is substance for a nightmare.

The wine is far from the finished product at this stage. It is quite low in alcohol, and contains unfermented sugar, excess tartaric acid, and tannin in solution. The liquid is cloudy, because of the presence of yeast cells, albuminous materials, pectin, etc., and it has a harsh flavor and grapey aroma. In order to develop a clarified liquid of true wine character, a secondary fermentation is carried out. The wine is stored in oak casks at 50 degrees Fahrenheit during the winter months, and settling of impurities results, aided by the formation of potassium acid tartrate crystals. At the approach of warm weather, a

(*Continued on page* 22)

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600 W. 59th St., New York, N. Y.

PAUL O. REYNEAU '13, Secretary-Treasurer and Placement Director
Cornell Club, 107 E. 48th St., New York, N. Y.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

Fellow Engineers:

In the last issue of the CORNELL ENGINEER Dean Hollister presented a statement that should be read by every Cornell engineer. He puts down on paper the scope and objectives of engineering education at Cornell as he sees them.

A privileged few of us had the opportunity to discuss this subject personally with Dean Hollister before he prepared his article, and I only wish that everyone interested in the future of engineering at Cornell, or who is thinking of sending his son to Cornell, could have heard his practical and forthright statement of educational policy.

The next best thing will be to read Dean Hollister's article. For those who do not receive the CORNELL ENGINEER, the Society has distributed a reprint of that article. It seems to us particularly desirable that every Cornellian who has a son who is soon going to Ithaca, or who knows of a potential candidate for engineering at Ithaca, should see that he reads this statement.

You may detect between the lines some enthusiasm on the part of your president for this statement. That would be correct. My enthusiasm is for what this statement signifies as to the future of engineering education at Cornell. It has been traditional that Cornell engineers stand in the forefront in accomplishment, and Dean Hollister has indicated that he plans to build further upon the solid foundation of the past. Cornell engineering tradition will be maintained by gearing its program to the needs of the times.

* * *

By this time you who are members of the Society have received a copy of the annual letter. To those of you who laid it aside and have not yet read it, I would like to point out a number of highlights in the Society's year which are worthy of attention:

1. The Cornell Society of Engineers has elected its first honorary members, and it is with pleasure that we accept within our ranks our long-time honored friends Dean Emeritis A. W. ("Uncle Pete") Smith, and Dean Emeritus Dexter Kimball.

2. A new Regional Group was established in New Jersey with George N. Brown '08 as vice-president.

3. The Society made the following donations and awards for this year:

To those members of the CORNELL ENGINEER Board as designated by the Dean, $100.
To the two sophomores in each School of the College of Engineering, who have been outstanding in scholastic honors as determined by the Faculty, a book award of $10 each, or a total of $80.
To the Cornell Alumni Fund, to be ear-marked for the benefit of the Engineering College, $250.
To Cornell University for use in the work of the Placement Bureau, $250.

* * *

Once again we commend to you the work of the Placement Bureau under the direction of Herb Williams '25 in Ithaca, and in New York under the direction of our own secretary-treasurer, Paul O. Reyneau '13. In these days when the demand for engineers is tremendous, turn to these men with your problems.

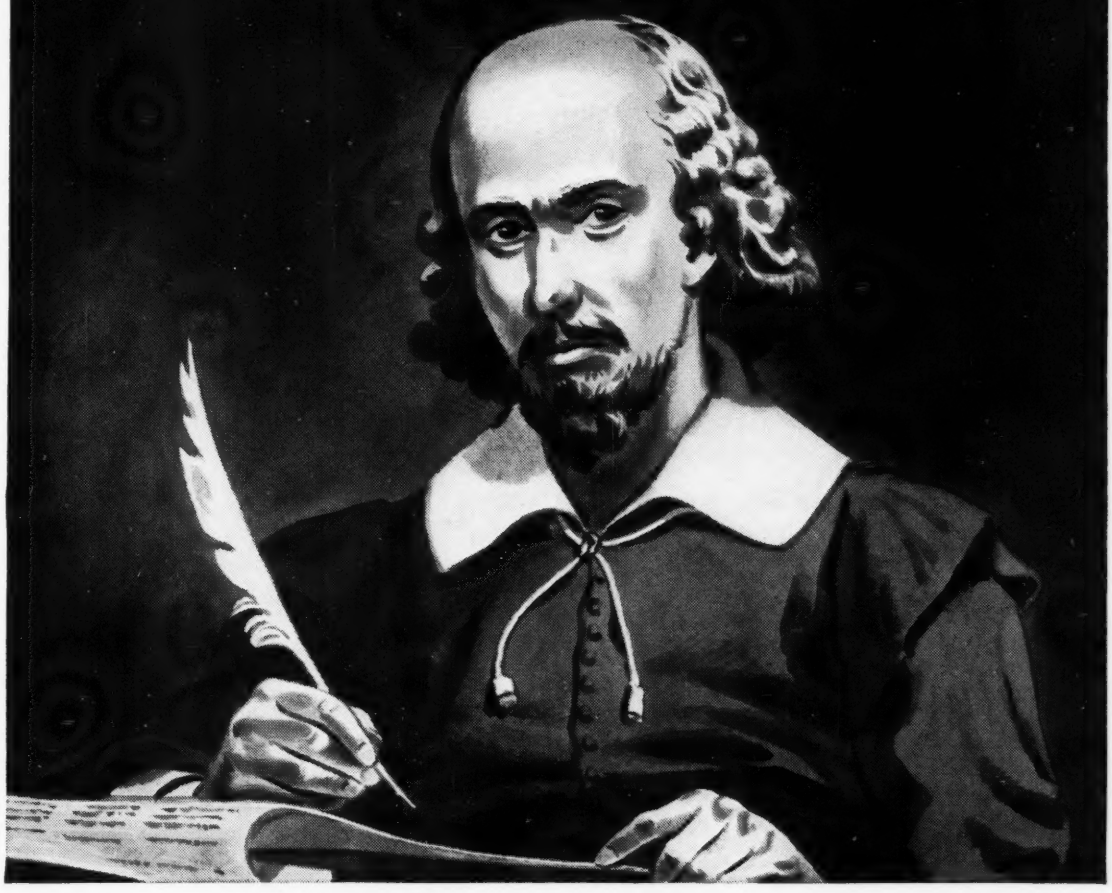
* * *

As this letter goes to press we have received word that an engineer, Tell Berna '12, general manager of the National Machine Tool Builders Association, is a candidate for the position of Trustee of the University. He is a prominent Cornellian with a brilliant record of accomplishment which qualifies him well for such an important post as Trustee. In accordance with the policy of the Society it urges its members to support the candidacy of engineers.

All members of the Society have been notified by the annual letter and we remind you now of the annual meeting to be held in New York at the Cornell Club on the evening of May 8th at 6:00 P. M. All members who can do so

(*Continued on page* 24)

Shakespeare didn't know the half of it!



...when he wrote "What's in a Name?"

The Bard of Avon was right about the rose—its name is unimportant. But if he'd had anything to do with naming telephone exchanges, he'd have learned a lot!

Names must be easy to pronounce and transmit—must not look or sound like other exchange names—must not use the same dial finger spaces.

Take MUIR and OTIS, for example. Fine!—except they *dial* alike! For the first two letters of each appear in the same finger spaces on the dial.

Often hundreds of names are listed, studied, discarded before *one* is found that meets all requirements. Such care in every phase of Bell System work helps to make your telephone service the world's finest.

Why not telephone home often? Long Distance rates to most points are lowest any night after 7 P. M. and all day Sunday.

BELL SYSTEM
AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES

CONCERNING *the* ALUMNI

Collyer Elected

The University Board of Trustees at a recent meeting elected John L. Collyer, M.E. '17, a Trustee for the unexpired term of the late Henry R. Ickelheimer, '88, to serve through June, 1945.

A short time ago we heard that Mr. Collyer had been elected president of the B. F. Goodrich Co., after working up from the bottom. His interest in the rubber industry is apparent when you review his work in England with the Dunlop Rubber Co., Ltd., with the same company in Buffalo and his rise to managing director of the Goodrich Rubber Co. in 1936, and then his elevation to the head of one of the largest rubber industries in the country.

His appointment as Trustee is another indication of his close contact with his Alma Mater. In addition to serving a president of the Student Council and being a member of Quill and Dagger, one of his main interests in his college days was rowing. After spending a year with the Cascadilla School crew, he went on to stroke successively the freshman and two varsity crews. The high point in this period of his career was stroking the Cornell boat to victory over a strong and highly favored California crew in the Poughkeepsie Regatta. His interest in the sport is still strong; for he represented Cornell as a steward of the Intercollegiate Rowing Association from 1931 to 1937. He is now engaged in working on a committee to secure funds for the development of sports facilities on the Cornell campus.

Carrier in Defense

Willis H. Carrier, M.E. '01, University Trustee, has been named by Secretary of War Stimson to a committee of outstanding engineers to advise the War Department in matters concerning civilian protection from air and other attacks in time of war.

Mr. Carrier is chairman of the board of the Carrier Corporation which is located in Syracuse, N. Y. He has contributed much to the engineering profession in the air conditioning and refrigeration field. His contributions to industry may be summed up by stating that he was chosen as one of the nineteen Modern Pioneers "whose achievements have made our American industrial system the envy and example of the world."

Cornellians Build

The excavation work for Olin Hall of Chemical Engineering, the new $700,000 building for the College of Engineering, has been progressing quite satisfactorily in spite of the cold weather; and construction of the foundation will start in the early part of April. Previously, the Department of Buildings and Grounds had rerouted the steam and other service mains that cross the site of the new building. Plans have been carefully prepared to protect the row of elms which will remain along the east side of Central Avenue, in front of the new building. The schedule calls for completion of the structure in October of this year.

John Lowry, Inc., of New York City has the general contract, and has designated Raymond C. Orr, a graduate of the School of Civil Engineering at Cornell in 1922, as resident superintendent of construction. Consulting structural engineers are Edwards and Hjorth of New York. James L. Edwards, the member of the firm who will have charge of structural design, is a graduate of Cornell who received his B.S. degree in 1917. Consulting mechanical engineers are Clark, MacMullen and Riley of New York. William L. Durand, who entered Cornell with the class of 1907, is representing the firm on the project, supervising mechanical equipment. His father, William F. Durand, was a professor in Sibley College of Mechanical Engineering at Cornell from 1891 to 1904, and during his last year was director of the College, succeeding Dr. Robert H. Thurston.

Shreve, Lamb, and Harmon of New York are the architects. Richmond H. Shreve, a graduate of Cornell in 1902, is senior member of the firm. Harold C. Bernhard of the class of 1926 at Cornell has been in charge of the project in the firm's office. Also called into consultation on the final plans were William A. Delano, architect for Willard Straight Hall, and F. Ellis Jackson of the Cornell class of 1900, architect for Myron Taylor Hall.

The new home for the School of Chemical Engineering is the gift of Franklin W. Olin of Alton, Ill., a graduate of Cornell in 1886 and for many years a Trustee of the University. It is the first building in a group of five planned by the University for the College of Engineering, to give it adequate resources to maintain and broaden its tradition of leadership in engineering education. A three-story structure with more than 100,000 square feet of floor space, Olin Hall of Chemical Engineering will be one of the largest buildings on the campus and will give the University unsurpassed facilities for instruction and research in this field.

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NEWS *of* THE COLLEGE

Foundrymen Meet

More than 100 members of the American Foundrymen's Association gathered at Willard Straight Hall on Friday, March 14, for a regular meeting of the Central New York Chapter. Professor A. C. Davis of the College of Engineering is a member of the Board of Directors of the chapter.

During the afternoon, members inspected the sand research laboratory in the College, which is operated in cooperation with the National A.F.A. Dinner was served afterwards at Willard Straight.

Members who attended the meeting represented foundries in Utica, Syracuse, Geneva, Elmira, Auburn, Seneca Falls, Binghamton, and other cities in this area.

Ensigns Arrive

Forty-seven ensigns of the U. S. Naval Reserve came to the University on March 28 for a 16-week course in Diesel Engines. Their arrival brought the grand total of men enrolled in the College under the Engineering Defense Training program to 1,245.

During the last three weeks, new courses in Tool Engineering and Fluid Mechanics have added more than 150 students to the previous total, Dr. Arthur S. Adams, director of the program for the College of Engineering, has annonnced. The Tool Engineering course in Buffalo, which began on March 10, has an enrollment of 116, and the Fluid Mechanics course in Elmira has 40. The present totals in the three training centers maintained by the College are Buffalo, 844 in seven courses; Elmira, 121 in four courses; and Ithaca, 280 in six courses. All the courses are given without tuition charge under the national program supervised by the U. S. Office of Education, and are designed to give specialized engineering training for national defense. Instruction is at the college level.

The Diesel Engine course for Naval officers, directed by Professor A. C. Davis of the Department of Experimental Engineering, is different from other Cornell Defense Training Courses now in operation, all of which are part-time and given in the evenings or on Saturdays. The 47 ensigns sent to Cornell are giving full time to the training, taking two or three lectures each day and three five-hour laboratory periods each week.

The purpose of the course is to make them competent operating engineers on patrol vessels of the Navy. Sufficient instruction in the theory underlying this type of engine will be given so that they will understand how it functions, but primary emphasis will be placed on laboratory work. Possible causes for engine trouble will be explored, and practice will be given in definite procedures for repair, so that the engines may be kept in continuous operation. After completing the work at Cornell, the ensigns will be assigned to duty in the operation and maintenance of diesel engines on patrol vessels.

ASCE

On the twenty-seventh of February, the members of the student chapter of the ASCE heard talks given by fellow students at Cornell. Among the speakers at the meeting was Charles Plog, graduate student who came here from the University of Wisconsin where he graduated with his B.C.E. degree last June. He told the Society of his work during the past summer when he was employed by the Wisconsin Highway Commission. He described the preliminary work and the construction of the piers for the new deck plate girder bridge now being built across the Flambeau River at Ladysmith, Wisconsin.

Bill Freeman '41, spoke on "Grouting". Grouting is the process of pumping concrete underground in order to provide a firmer foundation for construction work to follow. Bill described the procedure used in closing cracks and crevices in the foundation of Black Rock Dam, New Hampshire. In his talk he brought out many of the practical aspects of the process, and described the pumping devices and the equipment used.

The third speaker was Paul Leighton, '42. He spoke to the society about the irrigation of the Snake River Valley at Twin Falls, Idaho. Paul is a native son of Twin Falls, and consequently was able to present an accurate and highly interesting picture of the irrigation work carried on there to transform a part of the desert into a flourishing city surrounded by fertile farm lands. An article by Paul on the same subject appeared in the last issue of the CORNELL ENGINEER.

The fourth and final speaker of the meeting was Glen Botsford, '41, who gave a short talk on the honor system.

The meeting was enjoyed by all who attended and more of the same type, featuring student speakers rather than visiting lecturers, are being planned for the future.

On Thursday, March 20, the members of the Society heard a talk by C. S. Slack, assistant city engineer at Syracuse, who spoke on "Grade Crossing Eliminations In Syracuse." During the past four years, all of the surface crossings have been or are being eliminated in the city of Syracuse.

The ASCE is also planning to hold a joint meeting with the Ithaca chapter sometime in the near future. All ASCE seniors will be invited to the meeting. This will give them an opportunity to meet some men who have been successful in their chosen field of civil engineering.

AI Chem E

Major Ford of the Cornell R.O.T.C. ordnance department spoke to the student members of the AI Chem E at the February meeting. Major Ford presented a

highly interesting talk on the subject "The Place of Chemical Engineering in the Program for National Defense."

At the March meeting, the members of the student chapter heard a talk by Mr. Clark, superintendent of the duPont Camphor Works and a Cornell graduate.

Plans are being formed to bring Professor Fenske of the Chemical Engineering faculty of Pennsylvania State College to speak at the society sometime during April.

New officers recently elected for the coming year are:

President—Frederick C. Sullivan
Secretary—Irving Gertzog
Treasurer—Robert K. Finn

All are members of the class of '42 (ChemE).

Kappa Tau Chi

Plans are being made by the members of Kappa Tau Chi, administrative engineering honorary society, for the publication of a special handbook for administrative engineers. This handbook will be published either this spring or next fall.

Recently initiated into the Society was Professor C. I. Millard of the Industrial Engineering Department of Cornell University.

ASME

Student members of the ASME heard a very interesting talk on March 5, by Dr. Arthur S. Adams, assistant to the Dean of the College of Engineering. Dr. Adams spoke on the engineering defense training courses being given in some 115 engineering colleges throughout the country in connection with our present national expansion and critical need for engineers. He most particularly discussed Cornell's part in the program.

Dr. Adams announced that $8,000,000 of the $54,000,000 appropriated by Congress for training men along engineering lines has been set aside for these college defense training courses, the rest being provided for vocational training schools.

Industry at present can use, and needs 50,000 engineering graduates. The engineering colleges of the country will turn out but 12,000 to 15,000 this June. As a result, the government has instituted these training courses in an effort to fill the needs of industry. These men, Dr. Adams point out, are not engineers, as they are given very little fundamental training. Instead, they are trained to perform a specific task.

Another fact brought out by Dr. Adams, is that in every case when Cornell has started a defense course, both here and in other cities, the enrollment has far exceeded the number originally planned on. By March 28, Cornell University had instituted its seventeenth defense course.

He also pointed out that it will be a long time before we can hope to attain the 50,000 planes a year desired by the President. The Curtiss plant, one of the largest in the country, employs 12,000 men and is capable of producing only 3,000 planes a year. At this rate, 17 such plants would be necessary before the 50,000 figure could be achieved —and we don't have them.

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Yellow River

(*Continued from page* 11)

Once these works are applied the foreshore and overbank areas will be regraded. As soon as one work is silted over, another is to be built on top of it and so on until the foreshore is built up to an elevation specified in the predetermined plan. This type of work is very flexible and can be changed easily if any changes in the river bed are necessary.

In the areas between the works the planting of trees is recommended to increase silt deposition. After the channel cross section has scoured to its final designed section the bank-protective works may be carried out; the river bed will then be permanently stable. The idea of protecting the foreshore was proposed hundreds of years ago. Ta-Cheng Wu erected a large stone tablet on the river bank near Yingtse. On it are inscribed the following words:

". . . The earth of the ancient foreshore is hard,
But it gradually crumbles away
When once it is struck by the force of the current,
Which draws nearer the main dike each day.
I am building a structure to strengthen the foreshore,
For as long as the latter remains
The main dike will never be in danger of failure—
A safe foreshore pays one for his pains."

A number of years after the foreshore-stabilizing works are completed the channel will cut deeply into the ground. If there are any excessively deep portions along the river we can regulate them by building submerged dikes at such points. Consequently the river will be regulated to one standard depth to facilitate the transportation of silt and water.

The Yellow River has the ability to open its own channel and also the ability to adjust itself. Those in charge of regulation of this river must fully understand this ability and must utilize all opportunities. The funds for regulation should be secured in advance so that when the opportunity arises it may be seized immediately. By doing this it is possible to obtain 100 parts of results for each part of effort. For example, after the flood of 1933 there were many places where the water was already confined to a single channel, the channel was scoured out naturally, and the foreshores were aggraded. But we did not seize the opportunity to apply bank-protective works. The opportunity that could not be bought for millions in gold was lost in the twinkling of an eye.

To Be Concluded Next Month

Wine Manufacture

(*Continued from page* 15)

treatment known as racking is performed. This consists of siphoning the wine from the casks, without disturbing the settled residue, into new clean casks. In siphoning, the wine absorbs oxygen from the air and the oxygen reacts with the remaining albuminoids in the wine and precipitates them. The oxygen also improves the flavor and color of the wine. The sequence of aging and racking is performed at intervals of a month to six months until the wine is ready for bottling. By modifying the conditions of storage, different grades of wine result. Sherry and madeira owe their flavor to aging at a higher temperature than is usual for most wines.

If the wine-maker is exceedingly lucky, he will now have good wine, but usually he will not. The wine must be treated for deficient sugar, acidity, tannin, and colloidal material. Correction for sugar is easily carried out by merely adding enough sugar to raise the sugar content to 20-28 percent.

Deficiency of acid in the wine is corrected by adding juice which is high in acid or by adding the proper amount of tartaric acid. Acid content should be about one percent. If an excess of acid is present in the wine, rapid maturing is prevented and the wine has a harsh flavor. Relief of acidity is accomplished in two ways: by "gallizing," which involves dilution of the wine with water and adding either grape or cane sugar to counteract the dilution of the sugar content, and by "chaptalizing," which consists of treating the acid wine with chalk and adding sugar. Both procedures impair the natural flavor of the wine and must be practiced with great discretion.

With red wines, deficiency of tannin is not a common occurrence, since the source of tannin, the grape skins, are present during the fermentation period and tannin is extracted in sufficient quantities. In white wine manufacture, such a condition does not exist, and the tannin must be corrected. This will be taken up later.

Most of the suspended material in the wine is relieved during aging and racking. But some of the particles are so small as to be of a colloidal nature. By "fining" the wine, this condition is relieved. Fining is carried out with the use of isinglass, gelatin, or egg white. Regardless of which fining agent is used, the process is essentially the same. As the fining agent is added to the wine, it dissolves, but upon standing, the fining agent reacts with the tannin of the solution to form insoluble tannates. As the tannates settle to the bottom they entrap the colloidal particles and carry them to the bottom.

Now that the wine has ripened satisfactorily and is apparently in good condition, it is desirable to arrest any further changes. This is done by pasteurizing. The process must be carefully controlled, or all the effort put forth thus far would be for naught. If complete pasteurization is effected, the wine loses much of its natural flavor, and if the process is not carried out at a high enough temperature, the wine is not pasteurized. A compromise is made, and the wine is pasteurized at temperatures ranging from 120 to 150 degrees Fahrenheit. Times of pasteurization vary from a few seconds at the high temperatures to a quarter-hour at the lower temperatures. This exacting control is possible, thanks to the machinery of the dairy industry.

White Wine

There is only one essential difference between white wine manufacture and red wine manufacture. The white wine is the result of a fermentation of pressed juice rather than, as in red wine manufacture, fermentation of the whole grapes. Consequently the ferment liquid does not posses the pigment of the grape skins, is quite devoid of tannin, and is low in acid content. White wine must receive greater care in handling because of the absence of these substances.

The grapes are pressed before fermentation, separating the beneficial yeasts of the grape skins from

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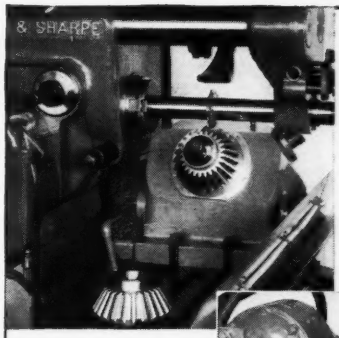
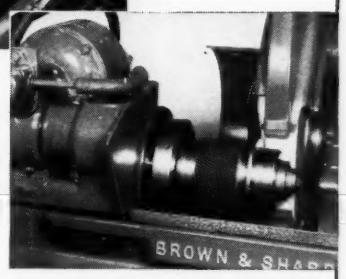


***Left*—Gear for retractable landing gear efficiently milled on No. 12 Plain Milling Machine.**



***Right*—Accurately sizing base of cylinder on No. 20 Plain Grinding Machine.**

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the must. Hence the desired fermentation process would be so slow as to allow the course of the fermentation to be controlled by the disease bacteria. This condition is corrected by sterilizing the must with sulfur dioxide and then starting the fermentation with a starter as in the case of red wine.

The pressing, aging, and racking processes are essentially the same as those for the red wine, but because of the low acid and tannin content, these processes must be carried out with greater care.

Correction of white wine involves all of the factors encountered in the correction of red wine, with the addition of a tannin correction. The tannin is added directly to the wine in a very small amount, say one part in 20,000. After the corrections have been made, fining is carried out and pasteurizing of the finished wine is invariably effected.

Parallel to the tremendous progress that chemistry has been making, there has been an increased amount of interest displayed in the chemistry of wine-making, and it is to be hoped that chemistry and chemical engineering can eliminate the empirical nature of wine manufacture and impart to it the stability which will insure the production of consistently fine wines.

Defense

(*Continued from page* 7)

the emphasis was on aircraft; after the fall of France, it centered on tanks.

Because of the inevitable lapse of time between decision and production, our industries must today win the battle that may engage our soldiers and sailors eighteen months from now. We cannot wait to meet the emergency when it arrives—by that time it must have been met.

A common feeling of desperate urgency must be injected into our defense program — a feeling so strong that we must be willing to make personal sacrifices. We are now giving up aluminum cooking utensils. We may shortly find that we must keep the old car going. We may do without a new pair of roller skates so that the manufacturer can concentrate on the production of, say, range finders, for the Government. In general, we must permit all available facilities to be directed toward the increased output of essential ordnance material, for unless every citizen is individually willing to make sacrifices, even a country with such vast potentialities as the United States cannot win a war. Though the emergency be long or short, each of us must realize that he has an essential part to play.

That feeling of desperate urgency is essential. A friend of mine in charge of a plant in Coventry, England, when asked how he weathered the merciless air raids, said to me, "We were lucky; a bomb exploded in the yard of our plant." "You were lucky that it didn't land on your plant," I said. "Yes," was the reply, "and it increased the production of my workers by 20%." We need the same sense of extreme urgency, for although the battle front is in the homes of England we are just as much a part of their defense as that plant in Coventry.

Because it does take time to set up the vast and complex machinery of mass production, because we do not know in specific terms when or where our emergency may arise, we must concentrate all of our energies on this problem. Admiral Stark summed it up in one sentence: "We cannot buy yesterday."

Vreeland

(*Continued from page* 13)

Committee which presented Glenn Miller as the feature attraction. As manager of 150 pound crew, he attended the Henley Regatta. Managing is not his only connection with the eight-oared shell, however, for George coxes for Phi Delta Theta in the intramural crew races. He also plays on the Phi Delt's football and volleyball teams. Like many of his fraternity brothers, who incidentally, elected him secretary of the chapter, George is fond of duck hunting and is a good authority on likely spots around Ithaca.

Nor has bearing down on the books to rank well in his class meant non-participation in other extra-curricular activities. In addition to having the time and qualifications for membership in Kappa Tau Chi, Quill and Dagger, and the Officer's Club, George has for the past year held the position of advertising manager for the CORNELL ENGINEER.

The vacation trip to Bermuda may be in the nature of a final fling, for on July 1 George will report for duty in the Arms and Maintainance Division of Army Ordnance. When his enlistment is up, George plans to enter the steel business. Nothing is certain, though, things being what they are, and George would not mind an Army career if he were not kept in one place too long.

Ross

(*Continued from page* 12)

and motion studies.

Throughout this past year he has been active in Alpha Phi Omega—a service fraternity—and has represented this magazine on the Student Engineering Council. He is now busily engaged in planning the program for the Cornell Day Show and is also in charge of the ME exhibits and publicity.

Much of Bob's time has been spent travelling for job interviews; he feels there is much valuable experience to be gained in these interviews and believes that it gives a senior a good over-all picture of the opportunities and working conditions in the different industries. Bob has made several trips in connection with the ASME, having recently represented the Cornell Student Branch at a convention held at the Hotel Astor in New York.

Bob's social fraternity is Sigma Nu, of which he is president. When he has time he participates on the house softball and volleyball teams. But the recreations he enjoys most are golfing and sailboat racing.

Like many of this year's seniors Bob can look forward to at least one year's active duty in the Army. He has already been called, but hopes for a sixty-day deferment which will permit him to lead a group of Rochester scouts on a pack-horse camping trip through the Southwest.

Message

(*Continued from page* 16)

are urged to come and bring other Cornell engineering guests. In addition to transacting the business of the Society we hope to have a good speaker who will be of interest to all, as well as many of our friends from the Faculty. It is our hope to make it a real engineering reunion.

Sincerely,
John P. Syme, '26
President

STRESS *and* STRAIN

Bum: "Say, buddy, could you let me have a dime for a cup of coffee?"

Wise Man: "A dime? I thought coffee was only five cents."

Bum: "I know, but I've got a date."

* * *

Taxi Driver: "I take the next turn, don't I?"

Voice from rear seat: "Oh, yeah!"

* * *

He: What would I have to give you for a little kiss?

She (demurely after much thought): Chloroform.

* * *

Doctor: I'm sorry, but I'll have to open you up again. I can't find my other rubber glove.

Patient: Don't be silly! Here's a dollar. Go out and buy yourself another pair.

* * *

Little Jasper trembled with excitement. Such a project had never occurred before.

"I'll go alone. I'm not afraid, Mother. You've nursed me through childhood. Gad! I'll never forget. But I'm something of a man now. Yes, sir, one of that seething mass called youth. And what's more, I'm game. I don't need your help as I once did. Gee, mom, don't cry! We men gotta stick together. I won't be long—just wait."

Little Jasper's face beamed angelic nonchalance as he pushed open the door to the men's room.

—*Iowa Engineer*

* * *

"I wish we'd get a few shipwrecked sailors washed ashore," mused the cannibal chief. "What I need is a good dose of salts."

* * *

Prof.: "Just what is space?"

Stude: "I can't just express it, but I've got it in my head."

"Well, little fellow," said the grocer, "what can I do for you?"

"Please, mister, mother wants a bottle of good-natured alcohol."

* * *

Drunk in a telephone booth: Number nuthin! I want my peanuts.

* * *

"I was out with a drunk last night, and he headed right for a telephone pole."

"The dog!"

* * *

"Is this a poplar tree?"

"Naw, they seem to prefer the lamp post on the corner."

* * *

Prof: Did you follow me?

Stude: Yes sir, except when you were between me and the board.

Prof.: I try to make myself clear, but I can't make myself transparent.

Don't make this mistake

Bearings sometimes are regarded merely as incidental factors in machine design. This is a great mistake. Many an otherwise well-designed piece of equipment has failed to live up to expectations because of inefficient bearings.

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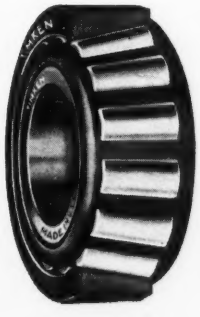

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G-E Campus News

INTRODUCING . . .

A NEW champion! The world's largest and most powerful industrial X-ray unit, packing a wallop equivalent to $90,000,000 worth of radium, is now at work in the General Electric plant at Schenectady.

Stronger by 600,000 volts than others in its class, the 1,000,000-volt monster clips down to two minutes the old record of an hour to take a picture through four inches of steel.

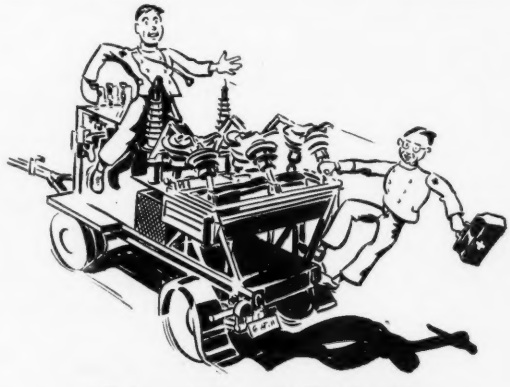
The machine is housed in a special building, with 14-inch concrete walls plus 12 inches of exterior brick to absorb stray radiations. Another safeguard for X-ray technicians is the X-ray safety "wrist watch"—a leather case, worn on the wrist, carrying a small piece of unexposed X-ray film. This, when developed at the end of the day, will show up any scattered X-radiation to which the wearer may have been harmfully exposed.

SCRAM, OXIDES!

WHEN a high-voltage cable fails, there's the devil to pay. Lights go out, breakers blow, production lines clatter to a halt, confusion reigns! Most cable troubles are caused by moisture, which seeps in through a break in the waterproof (lead sheath) covering.

Oxides are lead sheath's Enemy No. 1. They are born when the cable is being made; i.e., when the lead press is being charged. The lead is then molten and has its greatest affinity for oxygen.

General Electric engineers have solved this problem with the new "nozzle-swirl" process. In charging the lead press, any oxides present are collected, swirled to the center of the molten lead, pulled to the surface, and scooped off with a ladle. The nozzle—the secret of the whole process—was developed and patented by a graduate of the G-E Test Course, C.A. Piercy, Ohio State, '16.

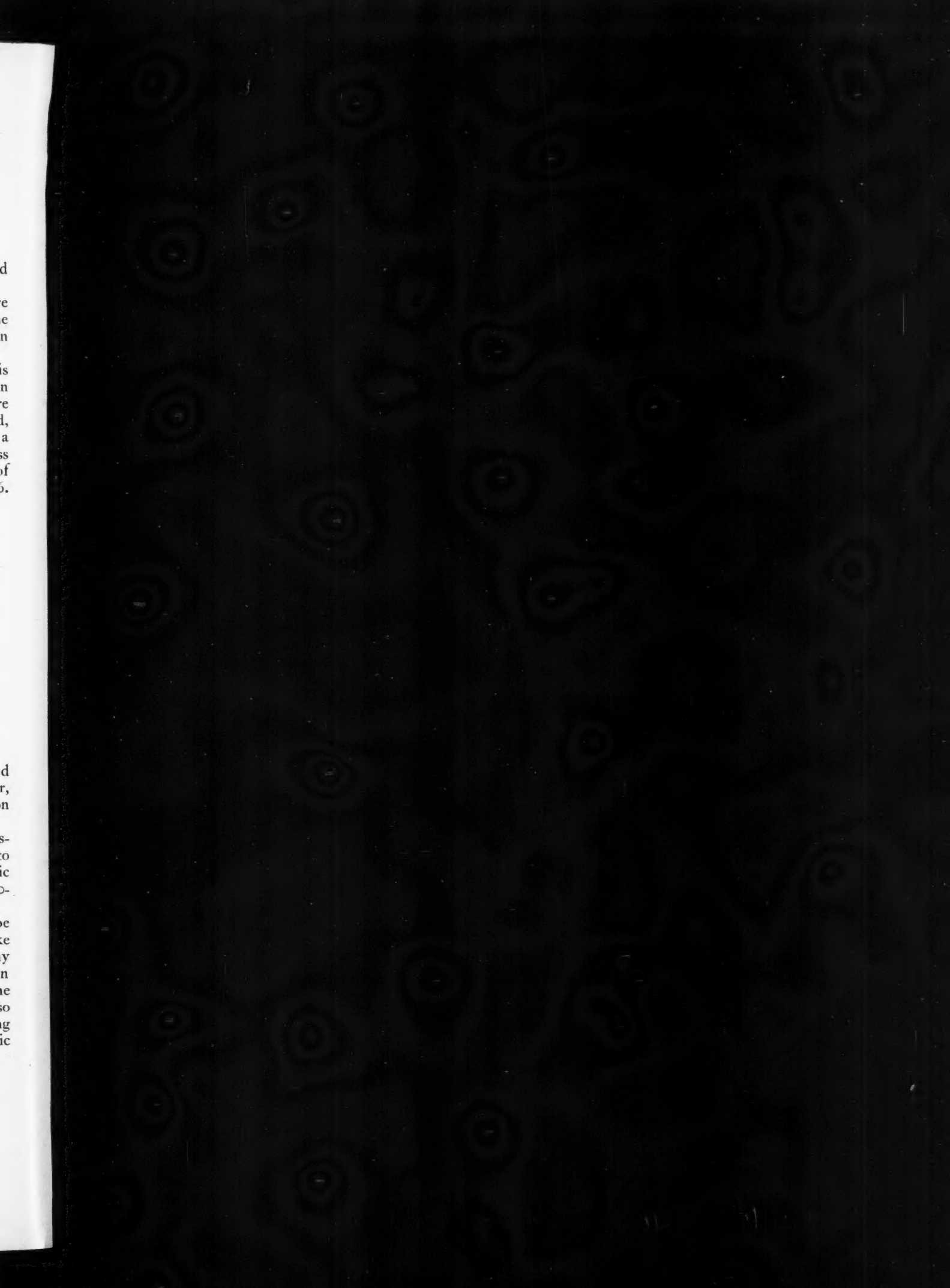


TO THE RESCUE

WHEN Mother Nature goes berserk, and whole towns are cut off from electric power, that's when repair crews go into sudden action to find the break and fix it.

In the past power companies have had transformers mounted on small trailers to be rushed to location to restore power. Now General Electric has announced a completely factory-built 1000-kva mobile substation, first of its type.

This unit, mounted on a huge trailer, can be towed along at 40 miles an hour. It can take power from high-voltage lines of almost any voltage and transform it to service values. When an outage occurs, the substation is whizzed to the spot, parked, grounded, and tied in. It can also be used to by-pass regular substations during repairs or maintenance work. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

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